

Amendments to the Specification

Please insert the following headings and paragraphs at page 2, line 3 of the specification prior to the Summary of the Invention section:

Data Over Cable Service Interface Specification (DOCSIS) Discussion

The DOCSIS specification defines the radio-frequency interface specifications for high-speed data-over-cable systems developed by Cable Television Laboratories for the cable industry. It is used to facilitate the design of interoperable hardware by multiple vendors. As stated above, the DOCSIS Specification (Versions 1.0 and 1.1) is incorporated fully herein by reference in its entirety. In particular, the Data-Over-Cable Service Interface Specifications, Radio Frequency Interface Specification, SP-RFIV1.1-I03-991105, Interim Specification, November 5, 1999 ("DOCSIS") will be referred to by section number elsewhere herein (e.g., "DOCSIS Section 4.2.7"). This summary of some sections of the DOCSIS specification provides background information to aid the reader in understanding certain embodiments of the present invention.

Cable Modem Initialization

In general, before a DOCSIS compliant cable modem (CM) may transmit upstream, it must be initialized. Initialization of a CM may be divided into the following phases: (1) Scan for downstream channel and establish synchronization with the Cable Modem Termination System (CMTS); (2) Obtain transmit parameters (from UCD message); (3) Perform ranging; (4) Establish IP connectivity; (5) Establish time of day; (6) Transfer operational parameters; (7) Perform registration; and (8) Baseline Privacy initialization (if so provisioned). (See DOCSIS sections 7.3.3; 9.2. - 9.2.9.) These steps

are described in detail elsewhere herein and illustrated in FIG. 9, blocks 900-912 and 922.

To register with the CMTS in phase (7) above, the CM forwards its configured class of service and any other operational parameters in the configuration file. (See DOCSIS section 9.2.8.) Certain encodings are found in the Registration Request and/or the Registration Response. For example, modem capabilities and vendor specific information are included in the registration request. (See DOCSIS sections C.1.3 - C.1.3.2; C1.1.17).

Upstream Bandwidth Allocation

In DOCSIS, upstream bandwidth is divided into a stream of mini-slots, each of which is numbered relative to a master reference maintained by the CMTS. The CMTS generates the time reference for identifying the slots, and controls access to the slots by transmitting an upstream bandwidth allocation map (MAP) message on the downstream channel. For example, the MAP message may describe some slots as grants for data transmission to particular CMs, other slots as available for contention transmission, and other slots as an opportunity for new stations to join the link. The MAP is discussed in detail elsewhere herein and in FIG.s 4 and 5. CMs may request upstream bandwidth from the CMTS. Each CM times its transmissions so that the CMTS receives it in the specified time reference. (See DOCSIS 7.1; see also DOCSIS Media Access Control (MAC) elsewhere herein).

DOCSIS Physical Media Dependent Sublayer

The DOCSIS Physical Media Dependent (PMD) Sublayer is described in DOCSIS Section 4. This section defines electrical characteristics and protocols for a CM

and CMTS with the aim of upstream and downstream interoperability between any compliant CM and CMTS.

The upstream PMD sublayer uses a FDMA/TDMA burst modulation format, providing five symbol rates and two modulation formats (QPSK and 16QAM). The modulation format includes pulse shaping for spectral efficiency, is carrier-frequency agile, and has selectable output power level. The PMD sublayer format includes a variable-length modulated burst with precise timing beginning at boundaries spaced at integer multiples of 6.25 msec apart (which is 16 symbols at the highest data rate). Each burst supports flexible modulation, symbol rate, preamble, randomization of the payload, and programmable FEC encoding. All of the upstream transmission parameters associated with CM burst transmission outputs are configurable by the CMTS via MAC messaging. Many of the parameters are programmable on a burst-by-burst basis. (See DOCSIS section 4.2.1.)

DOCSIS divides the upstream channel transmission characteristics into three portions: (a) Channel Parameters, (b) Burst Profile Attributes, and (c) User Unique Parameters. The Channel Parameters include the symbol rate, the center frequency, and the 1024-bit Preamble Superstring. The Burst Profile Attributes are shared attributes corresponding to a burst type. The User Unique (Burst) Parameters may vary for each user even when using the same burst type on the same channel as another user. (See DOCSIS section 4.2.7). User Unique Parameters include Power Level, Offset Frequency (a fine frequency tuning/adjust), Ranging Offset (microseconds), Burst Length in mini-slots (optional, changes burst to burst), and Transmit Equalizer Coefficients. The CM must support all burst profiles commanded by the CMTS via the burst descriptors in the

UCD and subsequently assigned for transmission in an allocation MAP message. (See DOCSIS section 4.2.7 Table 4-5.)

At higher channel widths, the symbol rate is higher. For example, the maximum channel width (i.e., the -30db bandwidth) for a 160 ksym/sec symbol rate is 200 kHz. At 640 ksym/sec, the bandwidth increases to 800 kHz. At 2,560 ksym/sec, the bandwidth is 3,200 kHz. (See DOCSIS section 4.2.2.3 Table 4-3).

DOCSIS Media Access Control (MAC)

The DOCSIS MAC protocol features include: bandwidth allocation controlled by a CMTS; a stream of mini-slots in the upstream; mixed contention- and reservation-based upstream transmit opportunities; support of variable-length packets for bandwidth efficiency; support for a wide range of data rates, and quality of service support. (See DOCSIS 6.1.1.)

In DOCSIS, a MAC frame is the basic unit of transfer between MAC sublayers at the CMTS and the cable modem. The same basic structure is used in both the upstream and downstream directions. MAC frames are variable in length. The term “frame” is used in this context to indicate a unit of information that is passed between MAC sublayer peers. This is not to be confused with the term “framing” that indicates some fixed timing relationship. (See DOCSIS 6.2.2.)

MAC Management Messages are encapsulated in a standardized information frame which is encapsulated within the cable network MAC framing. (See DOCSIS 6.3.1.) An Upstream Channel Descriptor (UCD) management message is transmitted by the CMTS at periodic intervals. The UCD message defines the characteristics of the upstream channel. The UCD includes the following parameters: configuration change

count (increments when any values change), mini-slot size (in units of 6.25 microseconds), upstream channel ID, downstream channel ID, symbol rate, frequency, preamble pattern, and burst descriptor. Each burst descriptor includes the modulation type, a differential encoding flag, preamble length and offset, FEC information, guard time size, and maximum burst size (See DOCSIS 6.3.3.) During normal operation, the upstream burst parameters may be changed by the CMTS by announcing new values in an Upstream Channel Descriptor Message (UCD). (DOCSIS 9.3.2).

A ranging request is transmitted by a CM at initialization and on request from the CMTS to determine network delay and request power adjustment. The CMTS responds to the ranging request with the following parameters: service ID, upstream channel ID, ranging status (indicates whether upstream messages are being received within acceptable limits), timing adjust information (the time by which to offset frame transmission so that the frame arrives at the expected mini-slot time at the CMTS), power adjust information (to ensure transmissions arrive at the CMTS at the desired power level), frequency adjust information (fine frequency adjust within a channel), CM transmitter equalization information, and upstream channel ID Override (identifies a channel with which the CM should redo initial ranging). (See DOCSIS 6.3.6.).